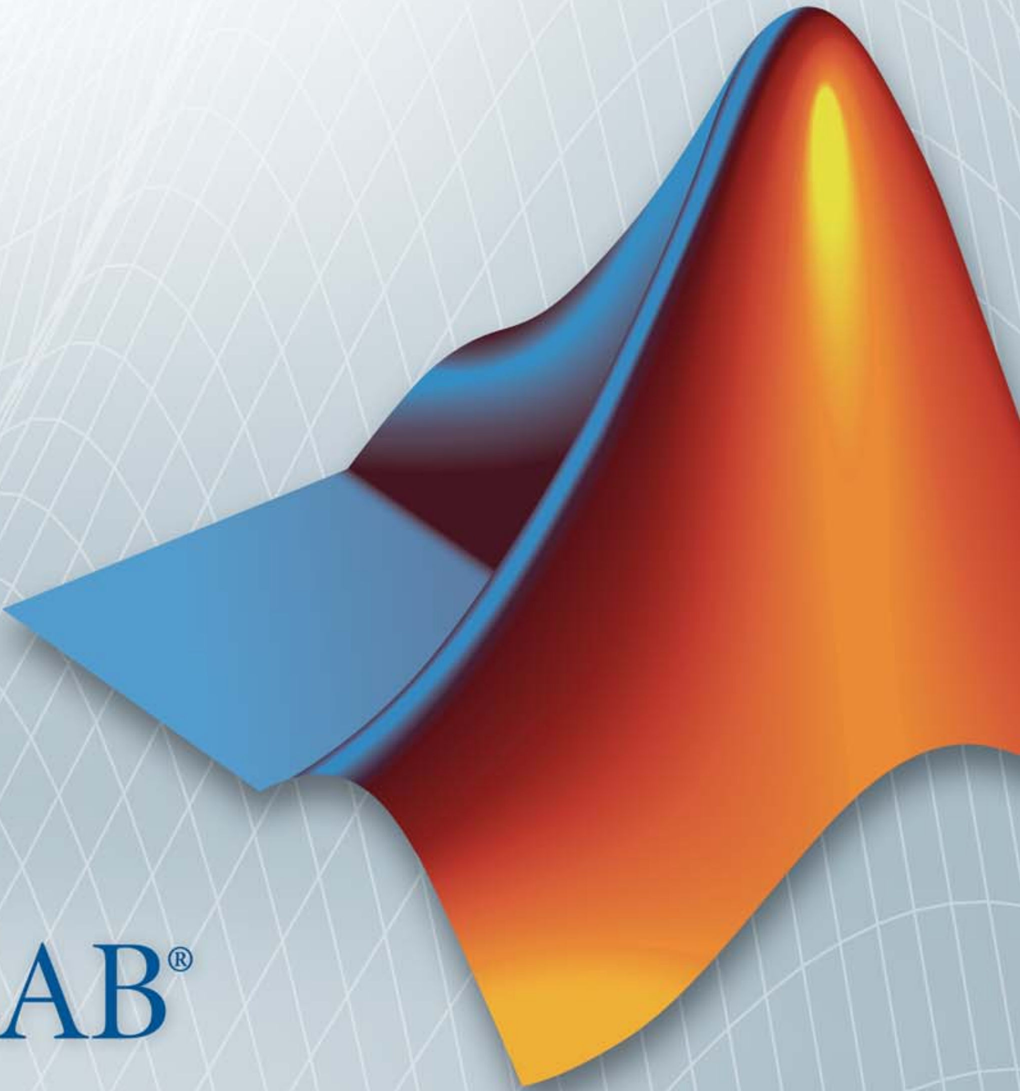
MATLAB® Distributed Computing Server™

System Administrator's Guide

R2012a



MATLAB®

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MATLAB® Distributed Computing Server™ System Administrator's Guide

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Contents

Introduction

Product Description

Perform MATLAB® and Simulink® computations on computer clusters and server farms

MATLAB Distributed Computing Server™ lets users solve computationally and data-intensive problems by executing MATLAB and Simulink based applications on a computer cluster.

MATLAB Distributed Computing Server is available for all hardware platforms and operating systems supported by MATLAB and Simulink. It includes a basic scheduler and directly supports Platform LSF®, Microsoft® Windows® Compute Cluster Server, Microsoft Windows HPC Server 2008, Altair® PBS Pro®, and TORQUE schedulers. Other schedulers can be integrated using the generic interface API. The product's dynamic licensing feature frees administrators from managing the license profiles of individual users on the cluster; only a single MATLAB Distributed Computing Server license is required for the cluster.

Users program and prototype applications on their desktops using Parallel Computing Toolbox™ and then scale up to a cluster using MATLAB Distributed Computing Server. The server can also be used to scale up executables and shared libraries generated from parallel MATLAB applications with MATLAB Compiler™.

Key Features

- Execution of MATLAB or Simulink applications on a computer cluster
- Dynamic licensing for executing applications that use eligible licensed toolboxes or blocksets
- Support for all hardware platforms and operating systems supported by MATLAB and Simulink
- Application scheduling using the MATLAB job scheduler (MJS) or third-party schedulers such as Platform LSF, Microsoft Windows HPC Server 2008, Microsoft Windows Compute Cluster Server, Altair PBS Pro, and TORQUE

Product Overview

In this section...

Parallel Computing Concepts

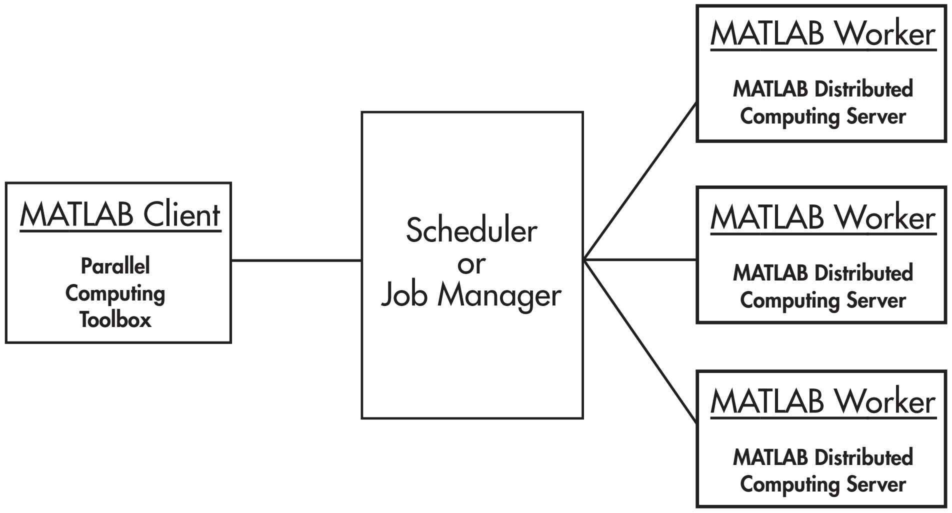
A *job* is some large operation that you need to perform in your MATLAB session. A job is broken down into segments called *tasks*. You decide how best to divide your job into tasks. You could divide your job into identical tasks, but tasks do not have to be identical.

The MATLAB session in which the job and its tasks are defined is called the *client* session. Often, this is on the machine where you program MATLAB. The client uses Parallel Computing Toolbox software to perform the definition of jobs and tasks. The MATLAB Distributed Computing Server product performs the execution of your job by evaluating each of its tasks and returning the result to your client session.

Parallel Computing Toolbox software allows you to run as many as 12 MATLAB workers on your local machine in addition to your MATLAB client session. MATLAB Distributed Computing Server software allows you to run as many MATLAB workers on a remote cluster of computers as your licensing allows. You can also use MATLAB Distributed Computing Server to run workers on your client machine if you want to run more than 12 local workers.

The MATLAB job scheduler (MJS) is the part of the server software that coordinates the execution of jobs and the evaluation of their tasks. The MJS distributes the tasks for evaluation to the server's individual MATLAB sessions called *workers*. Use of the MJS is optional; the distribution of tasks to workers can also be performed by a third-party scheduler, such as Window HPC Server (including CCS), a Platform LSF scheduler, or a PBS Pro scheduler.

See the "Glossary" on page Glossary-1 for definitions of the parallel computing terms used in this manual.


MATLAB Client
Parallel Computing Toolbox
Scheduler or Job Manager
MATLAB Worker
MATLAB Distributed Computing Server
MATLAB Worker
MATLAB Distributed Computing Server
MATLAB Worker
MATLAB Distributed Computing Server

Basic Parallel Computing Configuration

Determining Product Installation and Versions

To determine if Parallel Computing Toolbox software is installed on your system, type this command at the MATLAB prompt:

```
ver
```

When you enter this command, MATLAB displays information about the version of MATLAB you are running, including a list of all toolboxes installed on your system and their version numbers.

You can run the `ver` command as part of a task in a distributed or parallel application to determine what version of MATLAB Distributed Computing Server software is installed on a worker machine. Note that the toolbox and server software must be the same version.

Toolbox and Server Components

In this section...

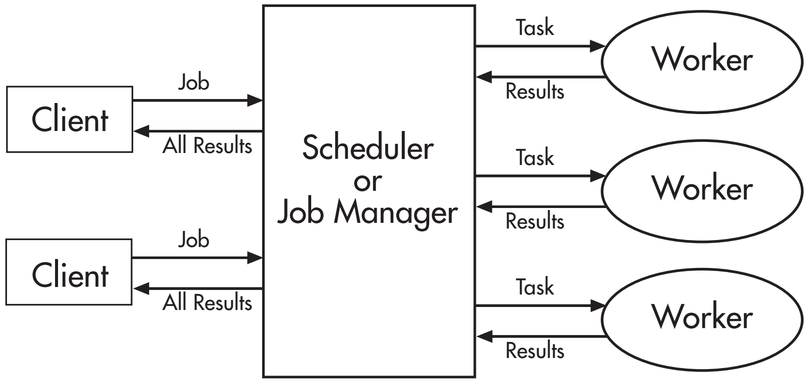
Schedulers, Workers, and Clients

The optional MJS can run on any machine on the network. The MJS runs jobs in the order in which they are submitted, unless any jobs in its queue are promoted, demoted, canceled, or destroyed.

Each worker receives a task of the running job from the MJS, executes the task, returns the result to the MJS, and then receives another task. When all tasks for a running job have been assigned to workers, the MJS starts running the next job with the next available worker.

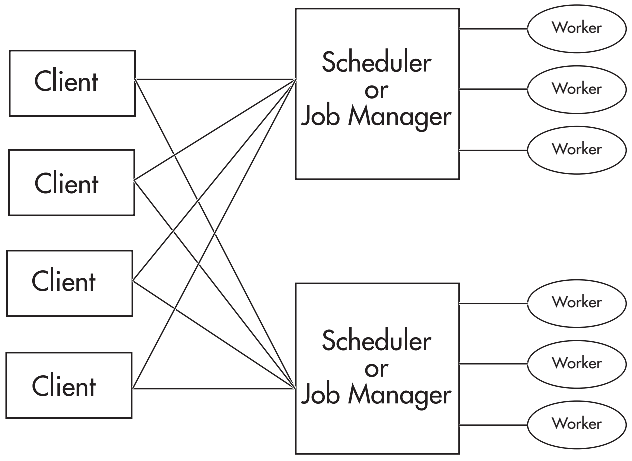
A MATLAB Distributed Computing Server network configuration usually includes many workers that can all execute tasks simultaneously, speeding up execution of large MATLAB jobs. It is generally not important which worker executes a specific task. Each worker evaluates tasks one at a time, returning the results to the MJS. The MJS then returns the results of all the tasks in the job to the client session.

Note For testing your application locally or other purposes, you can configure a single computer to host the client, workers, and MJS. You can also have more than one worker session or more than one MJS session on a machine.



Interactions of Parallel Computing Sessions

A large network might include several MJS sessions as well as several client sessions. Any client session can create, run, and access jobs on any MJS, but a worker session is registered with and dedicated to only one MJS at a time. The following figure shows a configuration with multiple MJS processes.



Configuration with Multiple Clients and MJS Processes

Third-Party Schedulers

As an alternative to using the MJS, you can use a third-party scheduler. This could be a Microsoft Windows HPC Server (including CCS), Platform LSF scheduler, PBS Pro scheduler, TORQUE scheduler, mpiexec, or a generic scheduler.

Choosing Between a Scheduler and MJS

You should consider the following when deciding to use a scheduler or the MJS for distributing your tasks:

- Does your cluster already have a scheduler?

  If you already have a scheduler, you may be required to use it as a means of controlling access to the cluster. Your existing scheduler might be just as easy to use as an MJS, so there might be no need for the extra administration involved.

- Is the handling of parallel computing jobs the only cluster scheduling management you need?

  The MJS is designed specifically for MathWorks® parallel computing applications. If other scheduling tasks are not needed, a third-party scheduler might not offer any advantages.

- Is there a file sharing configuration on your cluster already?

  The MJS can handle all file and data sharing necessary for your parallel computing applications. This might be helpful in configurations where shared access is limited.

- Are you interested in batch or interactive processing?

  When you use an MJS, worker processes usually remain running at all times, dedicated to their MJS. With a third-party scheduler, workers are run as applications that are started for the evaluation of tasks, and stopped when their tasks are complete. If tasks are small or take little time, starting a worker for each one might involve too much overhead time.

- Are there security concerns?

  Your scheduler may be configured to accommodate your particular security requirements.

- How many nodes are on your cluster?

  If you have a large cluster, you probably already have a scheduler. Consult your MathWorks representative if you have questions about cluster size and the MJS.

- Who administers your cluster?

  The person administering your cluster might have a preference for how jobs are scheduled.

Components on Mixed Platforms or Heterogeneous Clusters

Parallel Computing Toolbox software and MATLAB Distributed Computing Server software are supported on Windows, UNIX® (including Linux®), and Macintosh® operating systems. Mixed platforms are supported, so that the clients, MJS, and workers do not have to be on the same platform. The cluster can also be comprised of both 32-bit and 64-bit machines, so long as your data does not exceed the limitations posed by the 32-bit systems.

For a complete listing of all network requirements, including those for heterogeneous environments, see the System Requirements page for MATLAB Distributed Computing Server software at

```
http://www.mathworks.com/products/distriben/requirements.html
```

In a mixed platform environment, be sure to follow the proper installation instructions for each local machine on which you are installing the software.

mdce Service

If you are using the MJS, every machine that hosts a worker or MJS session must also run the mdce service.

The mdce service recovers worker and MJS sessions when their host machines crash. If a worker or MJS machine crashes, when mdce starts up again (usually configured to start at machine boot time), it automatically restarts the MJS and worker sessions to resume their sessions from before the system crash.

Using Parallel Computing Toolbox Software

A typical Parallel Computing Toolbox client session includes the following steps:

1. Find a cluster — Your network may have one or more MJS available (but usually only one scheduler). The function you use to find an MJS or scheduler creates an object in your current MATLAB session to represent the MJS or scheduler that will run your job.

2. Create a Job — You create a job to hold a collection of tasks. The job exists on the MJS (or scheduler's data location), but a job object in the local MATLAB session represents that job.

3. Create Tasks — You create tasks to add to the job. Each task of a job can be represented by a task object in your local MATLAB session.

4. Submit a Job to the Job Queue for Execution — When your job has all its tasks defined, you submit it to the queue in the MJS or scheduler. The MJS or scheduler distributes your job's tasks to the worker sessions for evaluation. When all of the workers are completed with the job's tasks, the job moves to the finished state.

5. Retrieve the Job's Results — The resulting data from the evaluation of the job is available as a property value of each task object.

6. Destroy the Job — When the job is complete and all its results are gathered, you can destroy the job to free memory resources.

Network Administration

This chapter provides information useful for network administration of Parallel Computing Toolbox software and MATLAB Distributed Computing Server software.

Prepare for Parallel Computing

In this section...

This section discusses the requirements and configurations for your network to support parallel computing.

Before You Start

Before attempting to install Parallel Computing Toolbox software and MATLAB Distributed Computing Server software, read Chapter 1, "Introduction" to familiarize yourself with the concepts and vocabulary of the products.

Plan Your Network Layout

Generally, it is easy to decide which machines will run worker processes and which will run client processes. Worker sessions usually run on the cluster of machines dedicated to that purpose. The MATLAB client session usually runs where MATLAB programs are run, often on a user's desktop.

The job manager process should run on a stable machine, with adequate resources to manage the number of tasks and amount of data expected in your parallel computing applications.

The following table shows what products and processes are needed for each of these roles in the parallel computing configuration.

Session	Product	Processes
Client	Parallel Computing Toolbox	MATLAB with toolbox
Worker	MATLAB Distributed Computing Server	worker; mdce service (if using a job manager)
Job manager	MATLAB Distributed Computing Server	mdce service; job manager

The server software includes the mdce service or daemon. The mdce service is separate from the worker and job manager processes, and it must be running on all machines that run job manager sessions or workers that are registered with a job manager. (The mdce service is not used with third-party schedulers.)

You can install both toolbox and server software on the same machine, so that one machine can run both client and server sessions.

Network Requirements

To view the network requirements for MATLAB Distributed Computing Server software, visit the product requirements page on the MathWorks Web site at

`http://www.mathworks.com/products/distriben/requirements.html`

Fully Qualified Domain Names

MATLAB Distributed Computing Server software and Parallel Computing Toolbox software support both short host names and fully qualified domain names. The default usage is short host names. If your network requires fully qualified host names, you can use the `mdce_def` file to identify the worker nodes by their full names. See “Customize Services” on page 2-13. To set the host name used for a MATLAB client session, see the `pctconfig` reference page.

Security Considerations

The parallel computing products do not provide any security measures. Therefore, be aware of the following security considerations:

- MATLAB workers run as whatever user the administrator starts the node's mdce service under. By default, the mdce service starts as `root` on UNIX operating systems, and as `LocalSystem` on Microsoft Windows operating systems. Because MATLAB provides system calls, users can submit jobs that execute shell commands.
- The mdce service does not enforce any access control or authentication. Anyone with local or remote access to the mdce services can start and stop their workers and job managers, and query for their status.
- The job manager does not restrict access to the cluster, nor to job and task data. Using a third-party scheduler instead of the MathWorks job manager could allow you to take advantage of the security measures it provides.
- The parallel computing processes must all be on the same side of a firewall, or you must take measures to enable them to communicate with each other through the firewall. Workers running tasks of the same parallel job cannot be firewalled off from each other, because their MPI-based communication will not work.
- If certain ports are restricted, you can specify the ports used for parallel computing. See "Define Script Defaults" on page 2-13.
- If your network supports multicast, the parallel computing processes accommodate multicast. However, because multicast is disabled on many networks for security reasons, you might require unicast communication between parallel computing processes. Most examples of parallel computing scripts and functions in this documentation show unicast usage.
- If your organization is a member of the Internet Multicast Backbone (MBone), make sure that your parallel computing cluster is isolated from MBone access if you are using multicast for parallel computing. This is generally the default condition. If you have any questions about MBone membership, contact your network administrator.

Install and Configure

To find the most up-to-date instructions for installing and configuring the current or past versions of the parallel computing products, visit the MathWorks Web site at

`http://www.mathworks.com/support/product/DM/installation/ver_current/`

Use a Different MPI Build on UNIX Operating Systems

In this section...

Build MPI

To use an MPI build that differs from the one provided with Parallel Computing Toolbox, this stage outlines the steps for creating an MPI build. If you already have an alternative MPI build, proceed to "Use Your MPI Build" on page 2-6.

1 Unpack the MPI sources into the target file system on your machine. For example, suppose you have downloaded `mpich2-distro.tgz` and want to unpack it into `/opt` for building:

```
# cd /opt
# mkdir mpich2 && cd mpich2
# tar zxvf path/to/mpich2-distro.tgz
# cd mpich2-1.0.8
```

2 Build your MPI using the `enable-sharedlibs` option (this is vital, as you must build a shared library MPI, binary compatible with `MPICH2-1.0.8` for R2009b and later). For example, the following commands build an MPI with the `nemesis` channel device and the `gforker` launcher.

```
# ./configure -prefix=/opt/mpich2/mpich2-1.0.8 \
 --enable-sharedlibs=gcc \
 --with-device=ch3:nemesis \
 --with-pm=gforker 2>&1 | tee log
# make 2>&1 | tee -a log
# make install 2>&1 | tee -a log
```

Use Your MPI Build

When your MPI build is ready, this stage highlights the steps to use it. To get the Parallel Computing Toolbox mpiexec scheduler working with a different MPI build, follow these steps. Most of these steps are also needed if you want to use a different MPI build with third party-schedulers (LSF, generic).

1 Test your build by running the `mpiexec` executable. The build should be ready to test if its `bin/mpiexec` and `lib/libmpich.so` are available in the MPI installation location.

   Following the example in "Build MPI" on page 2-6, `/opt/mpich2/mpich2-1.0.8/bin/mpiexec` and `/opt/mpich2/mpich2-1.0.8/lib/libmpich.so` are ready to use, so you can test the build with:

```
$ /opt/mpich2/mpich2-1.0.8/bin/mpiexec -n 4 hostname
```

2 Create an `mpiLibConf` function to direct Parallel Computing Toolbox to use your new MPI. Write your `mpiLibConf.m` to return the appropriate information for your build. For example:

```
function [primary, extras] = mpiLibConf
primary = '/opt/mpich2/mpich2-1.0.8/lib/libmpich.so';
extras  = {};
```

   The `primary` path *must* be valid *on the cluster*; and your `mpiLibConf.m` file must be higher on the cluster workers' path than *`matlabroot`*`/toolbox/distcomp/mpi`. (Sending `mpiLibConf.m` as a file dependency for this purpose does not work. You can get the `mpiLibConf.m` function on the worker path by either moving the file into a folder on the path, or by having the scheduler use `cd` in its command so that it starts the MATLAB worker from within the folder that contains the function.)

3 Determine necessary daemons and command-line options.

   - Determine all necessary daemons (often something like `mpdboot` or `smpd`). The `gforker` build example in this section uses an MPI that needs no services or daemons running on the cluster, but it can use only the local machine.
   - Determine the correct command-line options to pass to `mpiexec`.

4 Use one of the following options to set up your scheduler to use your new MPI build:

   - For the simplest case of the mpiexec scheduler, set up a configuration to use the `mpiexec` executable from your new MPI build. It is crucial that you use matching `mpiexec`, MPI library, and any daemons (if any), together. Set the configuration's `MpiexecFileName` property to `/opt/mpich2/mpich2-1.0.8/bin/mpiexec`.

- If you are using a third-party scheduler (either fully supported or via the generic interface), modify your parallel wrapper script to pick up the correct `mpiexec`. Additionally, there may be a stage in the wrapper script where the MPI daemons are launched.

  The parallel submission wrapper script must:

  - Determine which nodes are allocated by the scheduler.
  - Start required daemon processes. For example, for the MPD process manager this means calling `"mpdboot -f <nodefile>"`.
  - Define which mpiexec executable to use for starting workers.
  - Stop the daemon processes. For example, for the MPD process manager this means calling `"mpdallexit"`.

  For examples of parallel wrapper scripts, see the subfolders of *`matlabroot`*`/toolbox/distcomp/examples/integration/`; specifically for an example for Sun Grid Engine, look in the subfolder `sge/shared` for `parallelJobWrapper.sh`. Wrapper scripts are available for various schedulers and file sharing configurations. Adopt and modify the appropriate script for your particular cluster usage.

Shut Down a Job Manager Cluster

In this section...

If you are done using the job manager and its workers, you might want to shut down the server software processes so that they are not consuming network resources. You do not need to be at the computer running the processes that you are shutting down. You can run these commands from any machine with network access to the processes. The following sections explain shutting down the processes for different platforms.

UNIX and Macintosh Operating Systems

Enter the commands of this section at the prompt in a UNIX shell.

Stopping the Job Manager and Workers

1 To shut down the job manager, enter the commands

```
cd matlabroot/toolbox/distcomp/bin
```

(Enter the following command on a single line.)

```
stopjobmanager -remotehost <job manager hostname> -name
<MyJobManager> -v
```

If you have more than one job manager running, stop each of them individually by host and name.

For a list of all options to the script, type

```
stopjobmanager -help
```

2 For each MATLAB worker you want to shut down, enter the commands

```
cd matlabroot/toolbox/distcomp/bin
stopworker -remotehost <worker hostname> -v
```

If you have more than one worker session running, you can stop each of them individually by host and name.

```
stopworker -name worker1 -remotehost <worker hostname>
stopworker -name worker2 -remotehost <worker hostname>
```

For a list of all options to the script, type

```
stopworker -help
```

Stop and Uninstall the mdce Daemon

Normally, you configure the mdce daemon to start at system boot time and continue running until the machine shuts down. However, if you plan to uninstall the MATLAB Distributed Computing Server product from a machine, you might want to uninstall the mdce daemon also, because you no longer need it.

Note You must have `root` privileges to stop or uninstall the mdce daemon.

---

1. Use the following command to stop the mdce daemon:

   ```
   /etc/init.d/mdce stop
   ```

2. Remove the installed link to prevent the daemon from starting up again at system reboot:

   ```
   cd /etc/init.d/
   rm mdce
   ```

Stop the Daemon Manually. If you used the alternative manual startup of the mdce daemon, use the following commands to stop it manually:

```
cd matlabroot/toolbox/distcomp/bin
mdce stop
```

Microsoft Windows Operating Systems

Stop the Job Manager and Workers

Enter the commands of this section at the prompt in a DOS command window.

1 To shut down the job manager, enter the commands

```
cd matlabroot\toolbox\distcomp\bin
```

(Enter the following command on a single line.)

```
stopjobmanager -remotehost <job manager hostname> -name
<MyJobManager> -v
```

If you have more than one job manager running, stop each of them individually by host and name.

For a list of all options to the script, type

```
stopjobmanager -help
```

2 For each MATLAB worker you want to shut down, enter the commands

```
cd matlabroot\toolbox\distcomp\bin
stopworker -remotehost <worker hostname> -name <worker name> -v
```

If you have more than one worker session running, you can stop each of them individually by host and name.

```
stopworker -remotehost <worker hostname> -name <worker1 name>
stopworker -remotehost <worker hostname> -name <worker2 name>
```

For a list of all options to the script, type

```
stopworker -help
```

Stop and Uninstall the mdce Service

Normally, you configure the mdce service to start at system boot time and continue running until the machine shuts down. If you need to stop the mdce service while leaving the machine on, enter the following commands at a DOS command prompt:

```
cd matlabroot\toolbox\distcomp\bin
mdce stop
```

If you plan to uninstall the MATLAB Distributed Computing Server product from a machine, you might want to uninstall the mdce service also, because you no longer need it.

You do not need to stop the service before uninstalling it.

To uninstall the mdce service, enter the following commands at a DOS command prompt:

```
cd matlabroot\toolbox\distcomp\bin
mdce uninstall
```

Customize Services

In this section...

The MATLAB Distributed Computing Server scripts run using several default parameters. You can customize the scripts, as described in this section.

Define Script Defaults

The scripts for the server services require values for several parameters. These parameters set the process name, the user name, log file location, ports, etc. Some of these can be set using flags on the command lines, but the full set of user-configurable parameters are in the `mdce_def` file.

Note The startup script flags take precedence over the settings in the `mdce_def` file.

The default parameters used by the server service scripts are defined in the file:

- `*matlabroot*\toolbox\distcomp\bin\mdce_def.bat` (on Microsoft Windows operating systems)
- `*matlabroot*/toolbox/distcomp/bin/mdce_def.sh` (on UNIX or Macintosh operating systems)

To set the default parameters, edit this file before installing or starting the mdce service.

The `mdce_def` file is self-documented, and includes explanations of all its parameters.

Note If you want to run more than one job manager on the same machine, they must all have unique names. Specify the names using flags with the startup commands.

Set the User

By default, the job manager and worker services run as the user who starts them. You can run the services as a different user with the following settings in the `mdce_def` file.

Parameter	Description
`MDCEUSER`	Set this parameter to run the mdce services as a user different from the user who starts the service. On a UNIX operating system, set the value before starting the service; on a Windows operating system, set it before installing the service.
`MDCEPASS`	On a Windows operating system, set this parameter to specify the password for the user identified in the `MDCEUSER` parameter; otherwise, the system prompts you for the password when the service is installed.

On UNIX operating systems, `MDCEUSER` requires that the current machine has the `sudo` utility installed, and that the current user be allowed to use `sudo` to execute commands as the user identified by `MDCEUSER`. For further information, refer to your system documentation on the `sudo` and `sudoers` utilities (for example, `man sudo` and `man sudoers`).

The `MDCEUSER` is granted these permissions on Windows systems:

Privilege	Purpose	Local Security Settings Policy
SeServiceLogonRight	Required to log on using the service logon type.	Log on as a service
SeAssignPrimaryTokenPrivilege	Required to start a process under a different user account.	Replace a process level token
SeIncreaseQuotaPrivilege	Required to start a process under a different user account.	Adjust memory quotas for a process

To modify or remove these privileges,

1. Select the Windows menu **Start > Settings > Control Panel**.
2. Double-click `Administrative Tools`, then `Local Security Policy`.
3. In the tree, select `Local Policies`, then in the right pane, double-click `User Rights Assignment`.

The table above indicates which policies are affected by `MDCEUSER`. Double-click any of the listed policies in the Local Security Settings GUI to alter its setting or remove a user from that policy.

Override Script Defaults

Specify an Alternative Defaults File

The default parameters used by the mdce service, job managers, and workers are defined in the file:

- *`matlabroot`*`\toolbox\distcomp\bin\mdce_def.bat` (on Windows operating systems)
- *`matlabroot`*`/toolbox/distcomp/bin/mdce_def.sh` (on UNIX or Macintosh operating systems)

Before installing and starting the mdce service, you can edit this file to set the default parameters with values you require.

Alternatively, you can make a copy of this file, modify the copy, and specify that this copy be used for the default parameters.

On UNIX or Macintosh operating systems, enter the command

```
mdce start -mdcedef my_mdce_def.sh
```

On Windows operating systems, enter the command

```
mdce install -mdcedef my_mdce_def.bat
mdce start -mdcedef my_mdce_def.bat
```

If you specify a new `mdce_def` file instead of the default file for the service on one computer, the new file is not automatically used by the mdce service on other computers. If you want to use the same alternative file for all your mdce services, you must specify it for each mdce service you install or start.

For more information, see "Define Script Defaults" on page 2-13.

Note The startup script flags take precedence over the settings in the `mdce_def` file.

Start in a Clean State

When a job manager or worker starts up, it normally resumes its session from the past. This way, a job queue is not destroyed or lost if the job manager machine crashes or if the job manager is inadvertently shut down. To start up a job manager or worker from a clean state, with all history deleted, use the `-clean` flag on the `start` command:

```
startjobmanager -clean -name MyJobManager
startworker -clean -jobmanager MyJobManager
```

Access Service Record Files

In this section...
"Locate Log Files" on page 2-17
"Locate Checkpoint Folders" on page 2-18

The MATLAB Distributed Computing Server services generate various record files in the normal course of their operations. The mdce service, job manager, and worker sessions all generate such files. This section describes the types of information stored by the services.

Locate Log Files

Log files for each service contain entries for the service's operations. These might be of particular interest to the network administrator in cases when problems arise.

Operating System	File Location
Windows	The default location of the log files is `<TEMP>\MDCE\Log`, where `<TEMP>` is the value of the system `TEMP` variable. For example, if `TEMP` is set to `C:\TEMP`, the log files are placed in `C:\TEMP\MDCE\Log`. You can set alternative locations for the log files by modifying the `LOGBASE` setting in the `mdce_def.bat` file before starting the mdce service.
UNIX and Macintosh	The default location of the log files is `/var/log/mdce/`. You can set alternative locations for the log files by modifying the `LOGBASE` setting in the `mdce_def.sh` file before starting the mdce service.

Locate Checkpoint Folders

Checkpoint folders contain information related to persistence data, which the server services use to create continuity from one instance of a session to another. For example, if you stop and restart a job manager, the new session continues the old session, using all the same data.

A primary feature offered by the checkpoint folders is in crash recovery. This allows server services to automatically resume their sessions after a system goes down and comes back up, minimizing the loss of data. However, if a MATLAB worker goes down during the evaluation of a task, that task is neither reevaluated nor reassigned to another worker. In this case, a finished job may not have a complete set of output data, because data from any unfinished tasks might be missing.

Note If a job manager crashes and restarts, its workers can take up to 2 minutes to reregister with it.

Platform	File Location
Windows	The default location of the checkpoint folders is `<TEMP>\MDCE\Checkpoint`, where `<TEMP>` is the value of the system `TEMP` variable. For example, if `TEMP` is set to `C:\TEMP`, the checkpoint folders are placed in `C:\TEMP\MDCE\Checkpoint`. You can set alternative locations for the checkpoint folders by modifying the `CHECKPOINTBASE` setting in the `mdce_def.bat` file before starting the mdce service.
UNIX and Macintosh	The checkpoint folders are placed by default in `/var/lib/mdce/`. You can set alternative locations for the checkpoint folder by modifying the `CHECKPOINTBASE` setting in the `mdce_def.sh` file before starting the mdce service.

Set MJS Cluster Security

In this section...

Set the Security Level

You set the job manager or MJS security level with the `SECURITY_LEVEL` parameter in the `mdce_def` file before starting the mdce service on your cluster nodes. The `mdce_def` file indicates what values are allowed, and briefly describes each security level.

The following table describes the available security levels for accessing an MJS and its jobs.

Security Level	Description	User Requirements
0	No security. • Any user can access any job. • Tasks run as the user who started the mdce process on the worker machines (typically root or Local System). • This is the default, and is the behavior in all releases prior to R2010b.	• Jobs are associated with the default user name of the programmer, but no protection is provided.
1	Jobs are identified with the submitting user. • Any user can access any job; a dialog warns if the accessed job belongs to another user.	• A dialog requires you to establish a user name when you first access the job manager. • Your job manager (MJS) user name does not have to match your system/network user name.

Security Level	Description	User Requirements
	• Tasks run as the user who started the mdce process on the worker machines (typically root or Local System).	• No passwords are used.
2	Job manager (MJS) password protection on jobs. • Jobs and tasks are identified with the submitting user, and are password protected. Other users cannot access your jobs. • Tasks run as the user who started the mdce process on the worker machines (typically root or Local System).	• When you start the job manager (MJS), it prompts you to provide a new password for that job manager's admin account, which can be used for accessing all users' jobs and tasks. • A dialog box requires you to establish a user name and password when you first access the job manager (MJS) from the MATLAB client. • Your job manager (MJS) user name and password do not have to match your system/network user name and password.
3	In addition to the security of level 2, tasks run as the submitting user on worker machines. • Jobs and tasks are identified with the submitting user, and are password protected. Other users cannot access your jobs. • Tasks run as the user who submitted the job.	• On UNIX systems, the mdce process on the cluster nodes must be started by the root user. • The job manager (MJS) must use secure communication with the workers (set in the `mdce_def` file). • When you start the job manager (MJS), it prompts you to provide a new password for that job manager's admin account, which can be used for accessing all users' jobs and tasks. • A dialog box requires you to establish a user name and password when you first access the job manager (MJS) from the MATLAB client. • Your job manager (MJS) user name and password must be the same as

Security Level	Description	User Requirements
		your system/network user name and password, because the worker must log you in to run the task as you. • All users that tasks run as, require read and write permissions to the `CHECKPOINTBASE` folder and all its subfolders.

Local, MJS, and Network Passwords

For any security, the job manager (MJS) identifies every job with the user who submits the job. Therefore, whenever you access the MJS or a job, the MJS must be aware of who you are.

At security level 0, the MJS and job objects' `UserName` property is set to the login name of the person who creates the job; this setting can be changed at any time. For all higher security levels, the first access to the MJS causes a dialog box to open which asks for your username; if the security level is 2 or 3, you must also provide a password. The username and password you provide for the MJS needs to match your network username and password *only* if you are using security level 3; otherwise, you can create a new username and password unique for the MJS. For your convenience, you can choose how long to save your username and password on the local computer, so that you do not need to enter them every time you access your job.

For information about changing a password and logging out of an MJS, see `changePassword` and `logout`.

Set Secure Communication

To establish secure encrypted communication between job manager (MJS) and workers, set the `USE_SECURE_COMMUNICATION` parameter in the `mdce_def` file.

You must also provide a value for the `SHARED_SECRET_FILE` parameter in the `mdce_def` file, identifying where the file can be found from the job manager (MJS) perspective. To create this file, run either script:

- *`matlabroot`*`/toolbox/distcomp/bin/createSharedSecret` (UNIX)
- *`matlabroot`*`\toolbox\distcomp\bin\createSharedSecret.bat` (Windows)

The secret file establishes trust between the processes on different machines.

- In a shared file system, all the nodes can point to the same secret file, and they can even all share the same `mdce_def` file.
- In a nonshared file system, create a secret file with the provided script, then copy the file to each node and make sure each node's `mdce_def` file indicates where its particular secret file is located.

Note Secure communication is required when using job manager (MJS) security level 3.

Troubleshooting

In this section...

This section offers advice on solving problems you might encounter with MATLAB Distributed Computing Server software.

License Errors

When starting a MATLAB worker, a licensing problem might result in the message

```
License checkout failed. No such FEATURE exists.
License Manager Error -5
```

There are many reasons why you might receive this error:

- This message usually indicates that you are trying to use a product for which you are not licensed. Look at your `license.dat` file located within your MATLAB installation to see if you are licensed to use this product.
- If you are licensed for this product, this error may be the result of having extra carriage returns or tabs in your license file. To avoid this, ensure that each line begins with either `#`, `SERVER`, `DAEMON`, or `INCREMENT`.

  After fixing your `license.dat` file, restart your license manager and MATLAB should work properly.
- This error may also be the result of an incorrect system date. If your system date is before the date that your license was made, you will get this error.

- If you receive this error when starting a worker with MATLAB Distributed Computing Server software:
  - You may be calling the `startworker` command from an installation that does not have access to a worker license. For example, starting a worker from a client installation of the Parallel Computing Toolbox product causes the following error:

    ```
    The mdce service on the host hostname
    returned the following error:

    Problem starting the MATLAB worker.

    The cause of this problem is:

    ==============================================================
       Most likely, the MATLAB worker failed to start due to a
       licensing problem, or MATLAB crashed during startup.  Check
       the worker log file
       /tmp/mdce_user/node_node_worker_05-11-01_16-52-03_953.log
       for more detailed information.  The mdce log file
       /tmp/mdce_user/mdce-service.log
       may also contain some additional information.
    ===============================================================
    ```

    In the worker log files, you see the following information:

    ```
    License checkout failed.
    License Manager Error -15
    MATLAB is unable to connect to the license server.
    Check that the license manager has been started, and that the
    MATLAB client machine can communicate with the license server.

    Troubleshoot this issue by visiting:
    http://www.mathworks.com/support/lme/R2009a/15

    Diagnostic Information:
    Feature: MATLAB_Distrib_Comp_Engine
    License path: /apps/matlab/etc/license.dat
    FLEXnet Licensing error: -15,570. System Error: 115
    ```

- If you installed only the Parallel Computing Toolbox product, and you are attempting to run a worker on the same machine, you will receive this error because the MATLAB Distributed Computing Server product is not installed, and therefore the worker cannot obtain a license.

Memory Errors on UNIX Operating Systems

If the number of threads created by the server services on a machine running a UNIX operating system exceeds the limitation set by the `maxproc` value, the services fail and generate an out-of-memory error. Check your `maxproc` value on a UNIX operating system with the `limit` command. (Different versions of UNIX software might have different names for this property.)

Run Server Processes from a Windows Network Installation

Many networks are configured not to allow `LocalSystem` to have access to UNC or mapped network shares. In this case, run the mdce process under a different user with rights to log on as a service. See "Set the User" on page 2-14.

Required Ports

With Job Manager

BASE_PORT. The `mdce_def` file specifies and describes the ports required by the job manager and all workers. See the following file in the MATLAB installation used for each cluster process:

- *`matlabroot`*`/toolbox/distcomp/bin/mdce_def.sh` (on UNIX operating systems)
- *`matlabroot`*`\toolbox\distcomp\bin\mdce_def.bat` (on Windows operating systems)

Parallel Jobs. On worker machines running a UNIX operating system, the number of ports required by MPICH for the running of parallel jobs ranges from `BASE_PORT + 1000` to `BASE_PORT + 2000`.

With Third-Party Scheduler

Before the worker processes start, you can control the range of ports used by the workers for parallel jobs by defining the environment variable `MPICH_PORT_RANGE` with the value `minport:maxport`.

Client Ports

With the `pctconfig` function, you specify the ports used by the client. If the default ports cannot be used, this function allows you to configure ports separately for communication with the job manager and communication with pmode or a MATLAB pool.

Ephemeral TCP Ports with Job Manager

If you use the job manager on a cluster of nodes running Windows operating systems, you must make sure that a large number of ephemeral TCP ports are available on the job manager machine. By default, the maximum valid ephemeral TCP port number on a Windows operating system is 5000, but transfers of large data sets might fail if this setting is not increased. In particular, if your cluster has 32 or more workers, you should increase the maximum valid ephemeral TCP port number using the following procedure:

1. Start the Registry Editor.

2. Locate the following subkey in the registry, and click **Parameters**:

   ```
   HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Tcpip\Parameters
   ```

3. On the Registry Editor window, select **Edit > New > DWORD Value**.

4. In the list of entries on the right, change the new value name to `MaxUserPort` and press **Enter**.

5. Right-click on the `MaxUserPort` entry name and select **Modify**.

6. In the Edit DWORD Value dialog, enter `65534` in the **Value data** field. Select `Decimal` for the **Base** value. Click **OK**.

   This parameter controls the maximum port number that is used when a program requests any available user port from the system. Typically, ephemeral (short-lived) ports are allocated between the values of 1024 and 5000 inclusive. This action allows allocation for port numbers up to 65534.

7. Quit the Registry Editor.

8. Reboot your machine.

Host Communications Problems

If a worker is not able to make a connection with its job manager, or if a client session cannot find a job manager with the `findResource` function, this might indicate communications problems between nodes.

With Command-Line Interface

First, be sure that the machines in question agree on their IP resolutions. The IP address for a particular host should be the same for itself as it is from the perspective of another host. For example, if a process on `hostB` cannot connect to one on `hostA`, find out the `hostA` IP address for itself, then see what the IP address for `hostA` is from `hostB`. They should be the same.

If the machines can identify each other, the `nodestatus` command can be useful for diagnosing problems between their processes. Use the function to determine what MDCS processes are running on the local host, and which are accessible from remote hosts. If a worker on `hostA` cannot register with its job manager on `hostB`, run `nodestatus` on both hosts to see what each can see on `hostB`.

On `hostB`, execute:

```
nodestatus -remotehose hostB
```

Then on `hostA`, run exactly the same command:

```
nodestatus -remotehose hostB
```

The results should be the same, showing the same listing of job managers and workers.

If the output indicates problems, run the command again with a higher information level to receive more detailed information:

```
nodestatus -remotehose hostB -infolevel 3
```

With Admin Center GUI

You can diagnose some communications problems using Admin Center.

If you cannot successfully add hosts to the listing by specifying host name, you can use their IP addresses instead (see "Add Hosts" on page 3-3). If you suspect any communications problems, in the Admin Center GUI click **Test Connectivity** (see "Test Connectivity" on page 3-10). This testing verifies that the nodes can identify each other and allow their processes to communicate with each other.

Verify Multicast Communications

Note Although the current version of the parallel computing products continues to support multicast communications between its processes, multicast is not recommended and might not be supported in future releases.

Multicast, unlike TCP/IP or UDP, is a subscription-based protocol where a number of machines on a network indicate to the network their interest in particular packets originating somewhere on that network. By contrast, both UDP and TCP packets are always bound for a single machine, usually indicated by its IP address.

The main tools for investigating this type of packet are:

- `tcpdump` for UNIX operating systems
- `winpcap` and `ethereal` for Microsoft Windows operating systems
- A Java™ class included with the parallel computing products.

The Java class is called `com.mathworks.toolbox.distcomp.test.MulticastTester`. Both its static main method and its constructor take two input arguments: the multicast group to join and the port number to use.

This Java class has a number of simple methods to attempt to join a specified multicast group. Once the class has successfully joined the group, it has methods to send messages to the group, listen for messages from the group, and display what it receives. You can use this class both from a command-line call to Java software and inside MATLAB.

From a shell prompt (assuming that `java` is on your path), type

```
java -cp distcomp.jar com.mathworks.toolbox.distcomp.test.MulticastTester
```

You should see an output something like this:

```
0 : host1name : 0
1 : host2name : 0
```

The following example shows how to use the Java class inside MATLAB.

Start MATLAB on two machines (e.g., `host1name` and `host2name`) for which you want to test multicast. In each MATLAB session, enter the following commands:

```
m = com.mathworks.toolbox.distcomp.test.MulticastTester('239.1.1.1', 9999);
m.startSendingThread;
m.startListeningThread;
```

These instructions cause each MATLAB session to issue a stream of multicast test packets, and to listen for test packets. If multicast is working between the machines, you see a stream of lines like the following:

```
 0 : host1name : 0
 1 : host2name : 0
 2 : host2name : 1
 3 : host2name : 2
```

The number on the left in each string is the line number for the received packet. The text in the center is the host from which the packet is received. The number on the right is the packet number sent by the sending host. It is normal for a host to report a test packet from itself.

If either machine does not receive a stream of test packets, or if the remote host is not included in either stream, then multicast communication is not operating properly.

To terminate the test stream, execute the following in both MATLAB sessions:

```
m.stopSendingThread;
m.stopListeningThread;
```

Admin Center

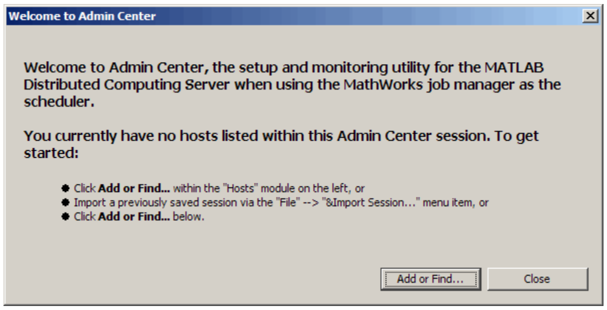
Start Admin Center

Admin Center is a graphical user interface that lets you control and verify MATLAB Distributed Computing Server resources if you are using an MJS cluster. Admin center does not support any CJS clusters.

You must start Admin Center outside a MATLAB session by executing the following:

- `*matlabroot*/toolbox/distcomp/bin/admincenter` (on UNIX operating systems)
- `*matlabroot*\toolbox\distcomp\bin\admincenter.bat` (on Microsoft Windows operating systems)

The first time you start Admin Center, you see a welcome dialog box.



Welcome to Admin Center, the setup and monitoring utility for the MATLAB Distributed Computing Server when using the MathWorks job manager as the scheduler.

You currently have no hosts listed within this Admin Center session. To get started:

- Click **Add or Find...** within the "Hosts" module on the left, or
- Import a previously saved session via the "File" --> "&Import Session..." menu item, or
- Click **Add or Find...** below.

A new session has no hosts listed, so the usual first step is to identify the hosts you want to include in your listing. To do this, click **Add or Find**. Further information continues in the next section.

If you start Admin Center again on the same host, your previous session for that machine is loaded; and unless the update rate is set to `never`, Admin Center performs an update immediately for the listed hosts and processes. To clear this information and start a new session, select the pull-down **File > New Session**.

Set Up Resources

In this section...

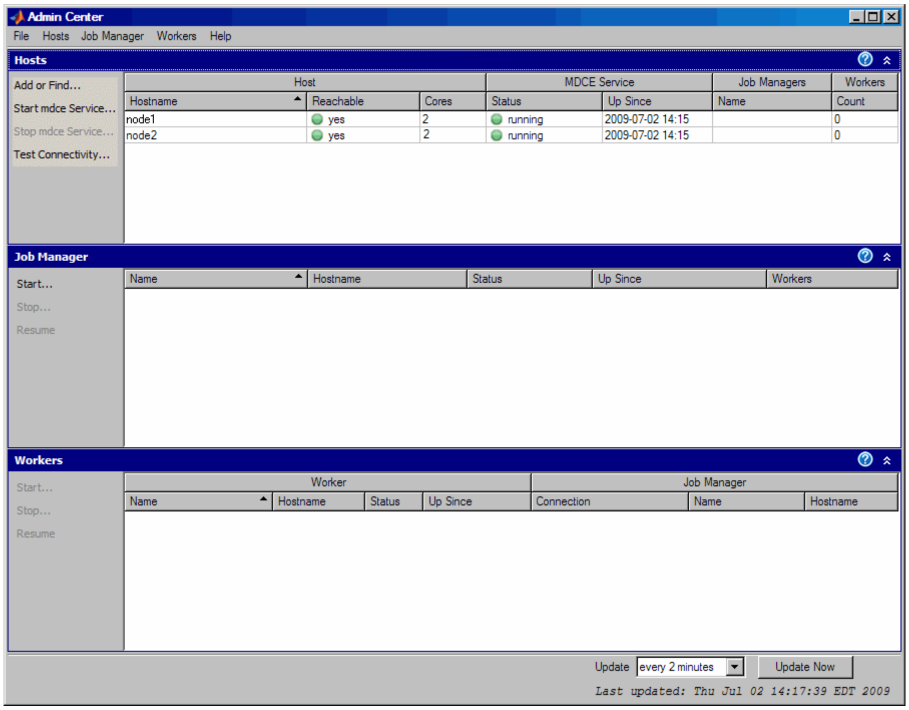
Add Hosts

To specify the hosts you want displayed in Admin Center, click **Add or Find** in the Welcome dialog box, or if this is not a new session, click **Add or Find** in the Hosts module.

In the Add or Find Hosts dialog box, identify the hosts you want to add to the listing by one of the following methods:

- Select **Enter Hostnames** and provide short host names, fully qualified domain names, or individual IP addresses for the hosts, or
- Select **Enter IP Range** and provide the range of IP addresses for your hosts.

If one of the hosts you have specified is running an MJS, Admin Center will automatically find and list all the hosts running workers registered with that job manager. Similarly, if you specify a host that is running a worker, Admin Center will find and list the host running that worker's job manager, and also all hosts running other workers under that job manager.



Host			MDCE Service		Job Managers	Workers
Hostname	Reachable	Cores	Status	Up Since	Name	Count
node1	● yes	2	● running	2009-07-02 14:15		0
node2	● yes	2	● running	2009-07-02 14:15		0

Name	Hostname	Status	Up Since	Workers

Worker				Job Manager		
Name	Hostname	Status	Up Since	Connection	Name	Hostname

Update every 2 minutes

Last updated: Thu Jul 02 14:17:39 EDT 2009

Start mdce Service

A host must be running the mdce service if a job manager or worker is to run on that host. Normally, you set this up with Admin Center or command-line scripts during the installation of MATLAB Distributed Computing Server on your cluster, as described in the installation instructions available at:

```
http://www.mathworks.com/support/product/DM/installation/ver_current/
```

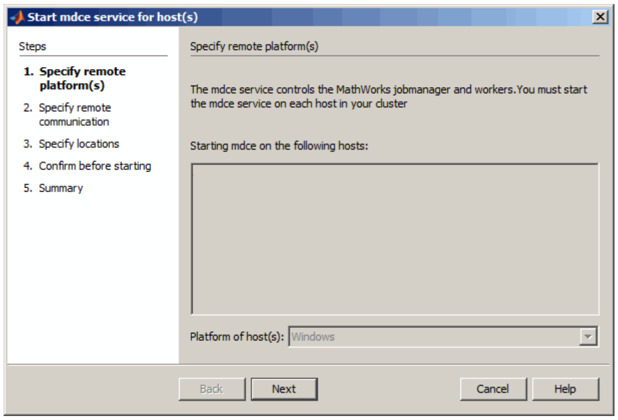
If you want to add hosts to your cluster or remove hosts, Admin Center allows you to start and stop mdce on those hosts. To start mdce on a group of hosts with the same platform, select all those hosts in the Hosts module, and click **Start mdce Service** in the left column of the panel.

Alternative methods for starting mdce include selecting the pull-down **Hosts > Start mdce Service**, or right-clicking a listed host and selecting, **Start mdce Service**.

A dialog box leads you through the procedure of starting mdce service on the selected hosts. There are five steps to the procedure in which you provide or confirm information for the service:

1. Specify remote platform — Windows or UNIX. You can start mdce on multiple hosts at the same time, but they all must be the same platform. If you have a mixed platform, run the mdce startup once for each type of platform.
2. Specify remote communication — Choose the protocol for communication with the hosts.
3. Specify locations — Specify the location of the MATLAB installation and the `mdce_def` file for the hosts.
4. Confirm before starting — Review information before proceeding.
5. Summary — Status about start attempt.

The dialog box looks like this for the first step:


Start mdce service for host(s)
Steps
1. Specify remote platform(s)
2. Specify remote communication
3. Specify locations
4. Confirm before starting
5. Summary
Back
Next
Cancel
Help

Specify remote platform(s)

The mdce service controls the MathWorks jobmanager and workers.You must start the mdce service on each host in your cluster

Starting mdce on the following hosts:

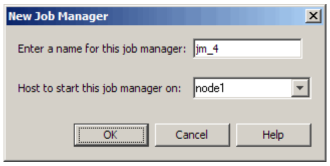
Platform of host(s): Windows

At each step, you can click **Help** to read detailed information about that step.

Start a Job Manager

To start a job manager, click **Start** in the Job Manager module.

In the New Job Manager dialog box, provide a name for the job manager, and select a host to run it on.



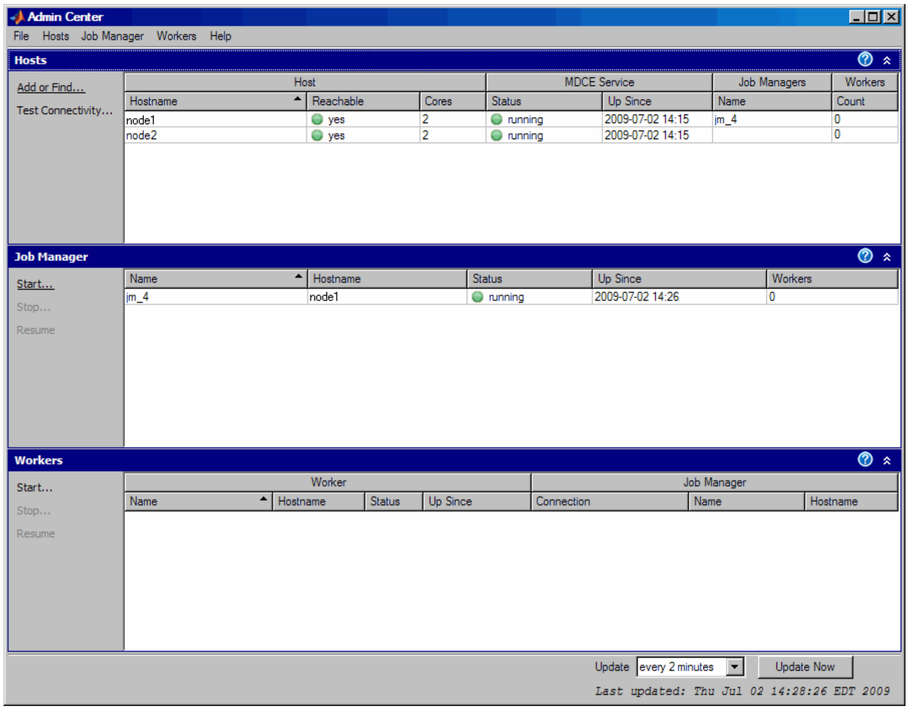
New Job Manager

Enter a name for this job manager: jm_4

Host to start this job manager on: node1

Alternative methods for starting a job manager include selecting the pull-down **Job Manager > Start**, or right-clicking a listed host and selecting, **Start Job Manager**.

With a job manager running on your cluster, Admin Center might look like the following figure, with the job manager listed in the Job Manager module, as well as being listed by name in the Hosts module in the line for the host on which it is running.



Hosts

Host			MDCE Service		Job Managers	Workers
Hostname	Reachable	Cores	Status	Up Since	Name	Count
node1	● yes	2	● running	2009-07-02 14:15	jm_4	0
node2	● yes	2	● running	2009-07-02 14:15		0

Job Manager

Name	Hostname	Status	Up Since	Workers
jm_4	node1	● running	2009-07-02 14:26	0

Workers

Worker				Job Manager		
Name	Hostname	Status	Up Since	Connection	Name	Hostname

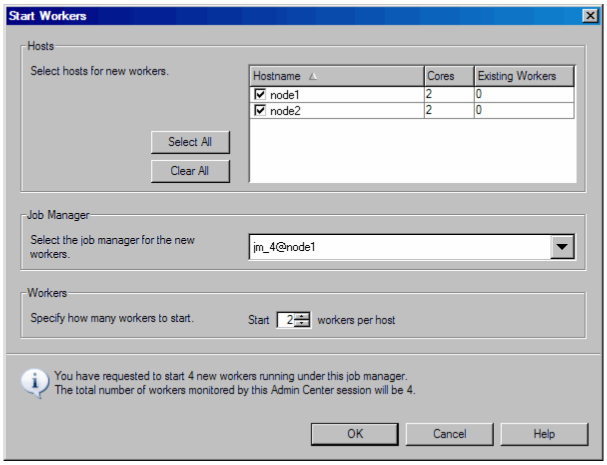
Update: every 2 minutes

`Last updated: Thu Jul 02 14:28:26 EDT 2009`

Start Workers

To start MATLAB workers, click **Start** in the Workers module.

In the Start Workers dialog box, specify the numbers of workers to start on each host, and select the hosts to run them. From the list, select the job manager for these workers. Click **OK** to start the workers. Admin center automatically provides names for the workers, based on the hosts running them.


Start Workers
Hosts
Select hosts for new workers.
Select All
Clear All
Job Manager
Select the job manager for the new workers.
Workers
Specify how many workers to start.
OK
Cancel
Help

Hostname	Cores	Existing Workers
☑ node1	2	0
☑ node2	2	0

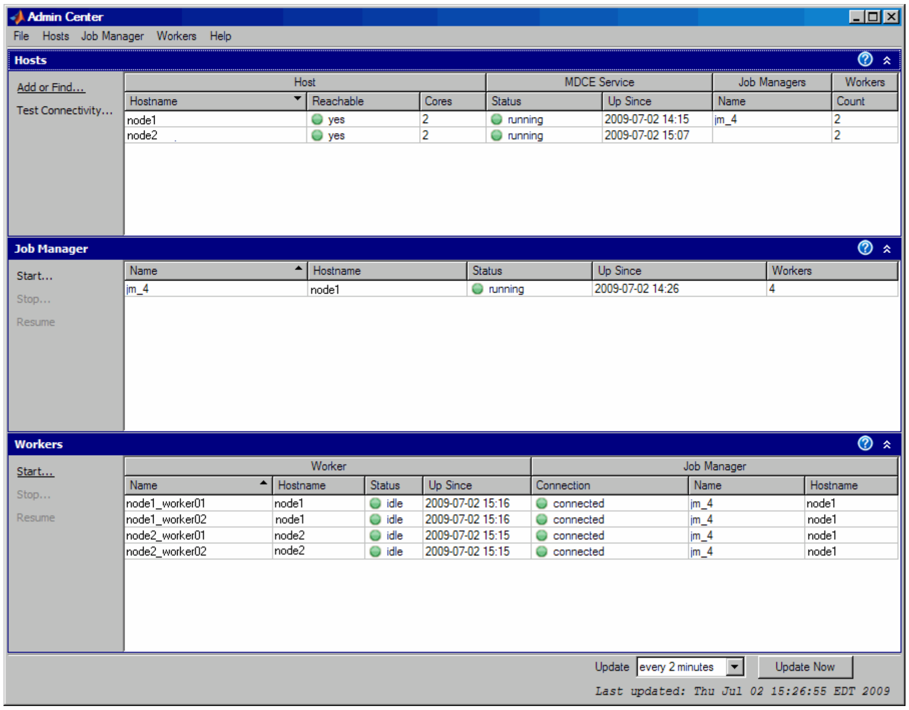
jm_4@node1

Start 2 workers per host

You have requested to start 4 new workers running under this job manager.
The total number of workers monitored by this Admin Center session will be 4.

Alternative methods for starting workers include selecting the pull-down **Workers > Start**, or right-clicking a listed host or job manager and selecting, **Start Workers**.

With workers running on your cluster, Admin Center might look like the following figure, which shows the workers listed in the Workers module. Also, the number of workers running under the job manager is listed in the Job Manager module, and the number of workers for each job manager is listed in the Hosts module.



Hosts

Add or Find...
Test Connectivity...

Host			MDCE Service		Job Managers	Workers
Hostname	Reachable	Cores	Status	Up Since	Name	Count
node1	● yes	2	● running	2009-07-02 14:15	jm_4	2
node2	● yes	2	● running	2009-07-02 15:07		2

Job Manager

Start...
Stop...
Resume

Name	Hostname	Status	Up Since	Workers
jm_4	node1	● running	2009-07-02 14:26	4

Workers

Start...
Stop...
Resume

Worker				Job Manager		
Name	Hostname	Status	Up Since	Connection	Name	Hostname
node1_worker01	node1	● idle	2009-07-02 15:16	● connected	jm_4	node1
node1_worker02	node1	● idle	2009-07-02 15:16	● connected	jm_4	node1
node2_worker01	node2	● idle	2009-07-02 15:15	● connected	jm_4	node1
node2_worker02	node2	● idle	2009-07-02 15:15	● connected	jm_4	node1

Update every 2 minutes   Update Now

Last updated: Thu Jul 02 15:26:55 EDT 2009

To get more information on any host, job manager, or worker listed in Admin Center, right-click its name in the display and select **Properties**. Alternatively, you can find the **Properties** option under the **Hosts**, **Job Manager**, and **Workers** drop-down menus.

Stop, Destroy, Resume, Restart Processes

You can **Stop** or **Destroy** the mdce service, job managers, and workers. The primary difference is that stopping a process shuts it down but retains its data; destroying a process shuts it down and clears its data. Use **Start mdce Service** to have mdce continue with existing data. Use **Resume** to have a a job manager or worker continue with its existing data. When you use **Restart**, a dialog box requires you to confirm your intention of starting a new process while keeping or discarding data.

Move a Worker

To move a worker from one host to another, you must completely shut it down, than start a new worker on the desired host:

1 Right-click the worker in the Workers module list.

2 Select **Destroy**. This shuts down the worker process and removes all its data.

3 If the old worker host is not running any other MDCS processes (mdce service, job manager, or workers), you might want to remove it from the Admin Center listing.

4 If necessary, add the new host to the Admin Center host listing.

5 In the Workers module, click **Start**. Select the desired host in the Start Workers dialog box, along with the appropriate number and job manager name.

Use a similar process to move a job manager from one host to another. Note, however, that all workers registered with the job manager must be destroyed and started again, registering them with the new instance of the job manager.

Update the Display

Admin Center updates its data automatically at regular intervals. To set the update rate, select an option from the **Update** list. Click **Update Now** to immediately update the display data.

Test Connectivity

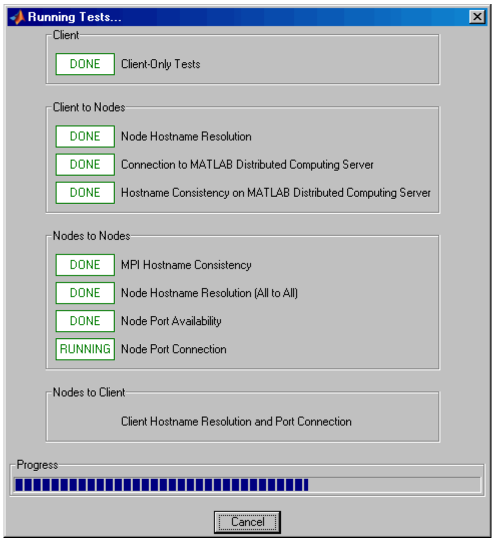
Admin Center lets you test communications between your job manager node, worker nodes, and the node where Admin Center is running.

The tests are divided into four categories:

- **Client** — Verifies that the node running Admin Center is properly configured so that further cluster testing can proceed.
- **Client to Nodes** — Verifies that the node running Admin Center can identify and communicate with the other nodes in the cluster.
- **Nodes to Nodes** — Verifies that the other nodes in the cluster can identify each other, and that each node allows its mdce service to communicate with the mdce service on the other cluster nodes.
- **Nodes to Client** — Verifies that other cluster nodes can identify and communicate with the node running Admin Center.

First click **Test Connectivity** to open the Connectivity Testing dialog box. By default, the dialog box displays the results of the last test. To run new tests and update the display, click **Run**.

During test execution, Admin Center displays this progress dialog box.



Client

DONE	Client-Only Tests

Client to Nodes

DONE	Node Hostname Resolution
DONE	Connection to MATLAB Distributed Computing Server
DONE	Hostname Consistency on MATLAB Distributed Computing Server

Nodes to Nodes

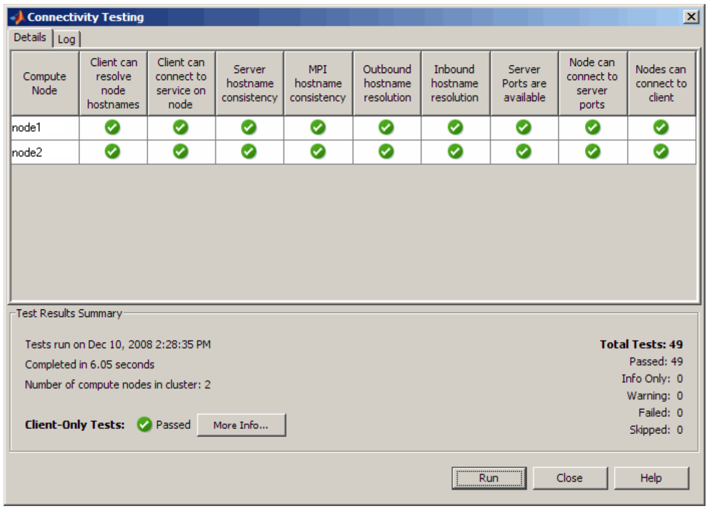
DONE	MPI Hostname Consistency
DONE	Node Hostname Resolution (All to All)
DONE	Node Port Availability
RUNNING	Node Port Connection

Nodes to Client

	Client Hostname Resolution and Port Connection

Progress

When the tests are complete, the Running Tests dialog box automatically closes, and Admin Center displays the test results in the Connectivity Testing dialog box.



Compute Node	Client can resolve node hostnames	Client can connect to service on node	Server hostname consistency	MPI hostname consistency	Outbound hostname resolution	Inbound hostname resolution	Server Ports are available	Node can connect to server ports	Nodes can connect to client
node1	✓	✓	✓	✓	✓	✓	✓	✓	✓
node2	✓	✓	✓	✓	✓	✓	✓	✓	✓

Test Results Summary

Tests run on Dec 10, 2008 2:28:35 PM
Completed in 6.05 seconds
Number of compute nodes in cluster: 2

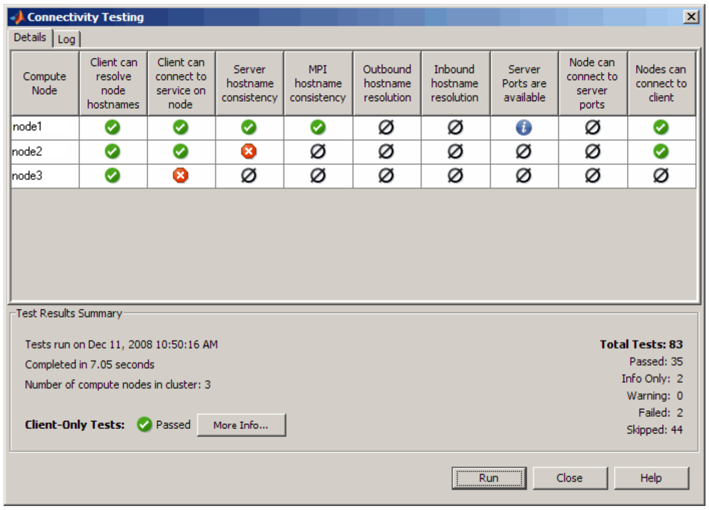
Client-Only Tests: ✓ Passed

Total Tests: 49
Passed: 49
Info Only: 0
Warning: 0
Failed: 0
Skipped: 0

The possible test result symbols are described in the following table.

Test Result	**Description**
✓	Test passed.
ℹ	Test passed, extra information is available.
⚠	Test passed, but generated a warning.
✗	Test failed.
∅	Test was skipped, possibly because prerequisite tests did not pass.

Test that include failures or other results might look like the following figure.



Compute Node	Client can resolve node hostnames	Client can connect to service on node	Server hostname consistency	MPI hostname consistency	Outbound hostname resolution	Inbound hostname resolution	Server Ports are available	Node can connect to server ports	Nodes can connect to client
node1	✓	✓	✓	✓	∅	∅	ℹ	∅	✓
node2	✓	✓	✗	∅	∅	∅	∅	∅	✓
node3	✓	✗	∅	∅	∅	∅	∅	∅	∅

Test Results Summary

Tests run on Dec 11, 2008 10:50:16 AM
Completed in 7.05 seconds
Number of compute nodes in cluster: 3

Client-Only Tests: ✓ Passed

Total Tests: 83
Passed: 35
Info Only: 2
Warning: 0
Failed: 2
Skipped: 44

Double-click any of the symbols in the test results to drill down for more detail. Use the **Log** tab to see the raw data from the tests.

The results of the tests that run on only the client are displayed in the lower-left corner of the dialog box. To drill into client-only test results, click **More Info**.

Save and Load Sessions

By default, Admin Center saves the cluster definition, process status, and test results, so the next time the same user runs Admin Center on the same machine, that information is available and displayed by default. You can export session data so that a different user or a different host can access it, by selecting the pull-down **File > Export**. Browse to the location where you want to store the session data and provide a name for the file. Admin Center applies the extension `.mdcs` to the file name.

You can import that saved session data into a subsequent session of Admin Center by selecting the pull-down **File > Import**. The imported data includes cluster definition and test results.

When identifying the file for importing in the Import Session dialog box, there is a **Disable updates** check box. Checking this box lets you import a session that does not automatically update, so that you can statically examine a cluster setup for evaluation or diagnostic purposes. Otherwise, unless the update rate is set to `never`, Admin Center performs an update immediately after starting or loading a session.

Prepare for User Profiles

Admin Center does not create cluster profiles, but the information displayed in Admin Center is of vital importance when you create your cluster profiles — information such as MJS name, MJS host, and number of workers. For more information about creating and using profiles, see “Cluster Profiles” in the Parallel Computing Toolbox documentation.

Control Script Reference

mdce Process Control

admincenter	Start Admin Center GUI
createSharedSecret	Create shared secret for secure communication
mdce	Install, start, stop, or uninstall mdce service
nodestatus	Status of mdce processes running on node
remotecopy	Copy file or folder to or from one or more remote hosts using transport protocol
remotemdce	Execute mdce command on one or more remote hosts by transport protocol

Job Manager Control

startjobmanager	Start job manager process
stopjobmanager	Stop job manager process

Worker Control

startworker	Start MATLAB worker session
stopworker	Stop MATLAB worker session

Control Scripts — Alphabetical List

Purpose

Start Admin Center GUI

Syntax

```
admincenter
```

Description

`admincenter` opens the MATLAB Distributed Computing Server Admin Center. When setting up or using a MATLAB job scheduler (MJS) cluster, Admin Center allows you to establish and verify your cluster, and to diagnose possible problems.

For details about using Admin Center, see Chapter 3, “Admin Center”.

See Also

`mdce` | `nodestatus` | `remotemdce`

Purpose

Create shared secret for secure communication

Syntax

```
createSharedSecret
createSharedSecret -file <filename>
```

Description

`createSharedSecret` creates a shared secret file used for secure communication between job managers and workers. The file is named `secret` in the current folder.

`createSharedSecret -file <filename>` create a shared secret file as the given filename.

Before passing sensitive data from one service to another (e.g., between job manager and workers), these services need to establish a trust relationship using a shared secret. This script creates a file that serves as a shared secret between the services. Each service is trusted that has access to that secret file.

Create the secret file only once per cluster on one machine, then copy it into the location specified by `SHARED_SECRET_FILE` in the `mdce_def` file on each machine before starting any job managers or workers. In a shared file system, all nodes can point to the same file. Shared secrets can be reused in subsequent sessions.

Examples

Create a shared secret file in a central location for all the nodes of the cluster:

```
cd matlabInstallDir/toolbox/distcomp/bin
createSharedSecret -file /share/secret
```

Then make sure that the nodes' shared or copied `mdce_def` files set the parameter `SHARED_SECRET_FILE` to `/share/secret` before starting the mdce service on each.

See Also

`mdce`

mdce

Purpose

Install, start, stop, or uninstall mdce service

Syntax

```
mdce install
mdce uninstall
mdce start
mdce stop
mdce console
mdce restart
mdce ... -mdcedef <mdce_defaults_file>
mdce ... -clean
mdce status
mdce -version
```

Description

The mdce service ensures that all other processes are running and that it is possible to communicate with them. Once the mdce service is running, you can use the `nodestatus` command to obtain information about the mdce service and all the processes it maintains.

The `mdce` executable resides in the folder *`matlabroot`*`\toolbox\distcomp\bin` (Windows operating system) or *`matlabroot`*`/toolbox/distcomp/bin` (UNIX operating system). Enter the following commands at a DOS or UNIX command-line prompt, respectively.

`mdce install` installs the mdce service in the Microsoft Windows Service Control Manager. This causes the service to automatically start when the Windows operating system boots up. The service must be installed before it is started.

`mdce uninstall` uninstalls the mdce service from the Windows Service Control Manager. Note that if you wish to install mdce service as a different user, you must first uninstall the service and then reinstall as the new user.

`mdce start` starts the mdce service. This creates the required logging and checkpointing directories, and then starts the service as specified in the mdce defaults file.

`mdce stop` stops running the mdce service. This automatically stops all job managers and workers on the computer, but leaves their checkpoint information intact so that they will start again when the mdce service is started again.

`mdce console` starts the mdce service as a process in the current terminal or command window rather than as a service running in the background.

`mdce restart` performs the equivalent of `mdce stop` followed by `mdce start`. This command is available only on UNIX and Macintosh operating systems.

`mdce ...  -mdcedef <mdce_defaults_file>` uses the specified alternative mdce defaults file instead of the one found in *`matlabroot`*`/toolbox/distcomp/bin`.

`mdce ...  -clean` performs a complete cleanup of all service checkpoint and log files before installing or starting the service, or after stopping or uninstalling it. This deletes all information about any job managers or workers this service has ever maintained.

`mdce status` reports the status of the mdce service, indicating whether it is running and with what PID. Use `nodestatus` to obtain more detailed information about the mdce service. The `mdce status` command is available only on UNIX and Macintosh operating systems.

`mdce -version` prints version information of the mdce process to standard output, then exits.

See Also

`nodestatus` | `startjobmanager` | `startworker` | `stopjobmanager` | `stopworker`

Purpose

Status of mdce processes running on node

Syntax

```
nodestatus
nodestatus -flags
```

Description

`nodestatus` displays the status of the mdce service and the processes which it maintains. The mdce service must already be running on the specified computer.

The `nodestatus` executable resides in the folder *`matlabroot`*`\toolbox\distcomp\bin` (Windows operating system) or *`matlabroot`*`/toolbox/distcomp/bin` (UNIX operating system). Enter the following command syntax at a DOS or UNIX command-line prompt, respectively.

`nodestatus -`*`flags`* accepts the following input flags. Multiple flags can be used together on the same command.

Flag	Operation
`-remotehost <hostname>`	Displays the status of the mdce service and the processes it maintains on the specified host. The default value is the local host.
`-infolevel <level>`	Specifies how much status information to report, using a level of 1-3. 1 means only the basic information, 3 means all information available. The default value is 1.

Flag	Operation
`-baseport <port_number>`	Specifies the base port that the mdce service on the remote host is using. You need to specify this only if the value of `BASE_PORT` in the local `mdce_def` file does not match the base port being used by the mdce service on the remote host.
`-v`	Verbose mode displays the progress of the command execution.

Examples

Display basic information about the mdce processes on the local host.

```
nodestatus
```

Display detailed information about the status of the mdce processes on host `node27`.

```
nodestatus -remotehost node27 -infolevel 2
```

See Also

`mdce` | `startjobmanager` | `startworker` | `stopjobmanager` | `stopworker`

remotecopy

Purpose

Copy file or folder to or from one or more remote hosts using transport protocol

Syntax

```
remotecopy <flags> <protocol options>
```

Description

`remotecopy` copies a file or folder to or from one or more remote hosts by using a transport protocol (such as rsh or ssh). Copying from multiple hosts creates a separate file per host, appending the hostname to the specified filename.

The general form of the syntax is:

```
remotecopy <flags> <protocol options>
```

Flags and Options	Operation
`-local <file-or-foldername>`	Specify the name of the file or folder on the local host.
`-remote <file-or-foldername>`	Specify the name of the file or folder on the remote host.
`-from`	Specify to copy from the remote hosts to the local host. You must use either the `-from` flag, or the `-to` flag.
`-to`	Specify to copy to the remote hosts from the local host. You must use either the `-from` flag, or the `-to` flag.
`-remotehost host1[,host2[,...]`	Specify the names of the hosts where you want to copy to or from. Separate the host names by commas without any white spaces. This is a mandatory argument.
`-remoteplatform { unix | windows }`	Specify the platform of the remote hosts. This option is required only if different from the local platform.

Flags and Options	Operation
`-quiet`	Prevent `remotecopy` from prompting for missing information. The command fails if all required information is not specified.
`-help`	Print the help information for this command.

`-protocol <`*`type`*`>`	Force the usage of a particular protocol type. Specifying a protocol type with all its required parameters also avoids interactive prompting and allows for use in scripts.
	
	The supported protocol types are `scp`, `sftp` and `rcp`.
	
	To get more information about one particular protocol type, enter
	
	`remotecopy -protocol <type> -help`
	
	For example:
	
	`remotecopy -protocol sftp -help`

`<protocol options>`	Specify particular options for the protocol type being used.

Note The file permissions on the copy might not be the same as the permissions on the original file.

Examples

Copy the local file `mdce_def.sh` to two other machines. (Enter this command on a single line.)

```
remotecopy -local mdce_def.sh -to
  -remote /matlab/toolbox/distcomp/bin -remotehost hostA,hostB
```

Retrieve folders of the same name from two hosts to the local machine. (Enter command on a single line.)

```
remotecopy -local C:\temp\log -from -remote C:\temp\mdce\log
  -remotehost winHost1,winHost2
```

See Also

`remotemdce`

Purpose

Execute mdce command on one or more remote hosts by transport protocol

Syntax

```
remotemdce <mdce options> <flags> <protocol options>
```

Description

`remotemdce` allows you to execute the mdce service on one or more remote hosts. For a description of the mdce service, see the `mdce` reference page. The general form of the syntax is:

```
remotemdce <mdce options> <flags> <protocol options>
```

The following table describes the supported flags and options. They can be combined in the same command. Note that flags are each preceded by a dash (-).

Flags and Options	Operation
<mdce options>	Options and arguments of the mdce command, such as `start`, `stop`, etc. See the `mdce` reference page for a full list.
`-matlabroot <installfoldername>`	The MATLAB installation folder on the remote hosts, required only if the remote installation folder differs from the one on the local machine.
`-remotehost host1[,host2[,...]`	The names of the hosts where you want to run the mdce command. Separate the host names by commas without any white spaces. This is a mandatory argument.
`-remoteplatform { unix | windows }`	The platform of the remote hosts. This option is required only if different from the local platform.
`-quiet`	Prevent mdce from prompting the user for missing information. The command fails if all required information is not specified.
`-help`	Print help information.

Flags and Options	Operation

`-protocol <type>`	Force the usage of a particular protocol type. Specifying a protocol type with all its required parameters also avoids interactive prompting and allows for use in scripts.
	
	The supported protocol types are `ssh`, `rsh`, and `winsc`.
	
	To get more information about one particular protocol type, enter
	
	`remotemdce -protocol <type> -help`
	
	For example:
	
	`remotemdce -protocol winsc -help`
	
	Using the `winsc` protocol requires that you log in as a user with admin privileges on the remote host.

`<protocol options>`	Specify particular options for the protocol type being used.

Note If you are using OpenSSHd on a Microsoft Windows operating system, you can encounter a problem when using backslashes in path names for your command options. In most cases, you can work around this problem by using forward slashes instead. For example, to specify the file `C:\temp\mdce_def.bat`, you should identify it as `C:/temp/mdce_def.bat`.

Examples

Start mdce on three remote machines of the same platform as the client:

```
remotemdce start -remotehost hostA,hostB,hostC
```

Start mdce in a clean state on two UNIX operating system machines from a Windows operating system machine, using the ssh protocol. Enter the following command on a single line:

```
remotemdce start -clean -matlabroot /usr/local/matlab
 -remotehost unixHost1,unixHost2 -remoteplatform UNIX
 -protocol ssh
```

See Also

`mdce` | `remotecopy`

startjobmanager

Purpose

Start job manager process

Syntax

```
startjobmanager
startjobmanager -flags
```

Description

`startjobmanager` starts a job manager process and the associated job manager lookup process under the mdce service, which maintains them after that. The job manager handles the storage of jobs and the distribution of tasks contained in jobs to MATLAB workers that are registered with it. The mdce service must already be running on the specified computer.

The `startjobmanager` executable resides in the folder *`matlabroot`*`\toolbox\distcomp\bin` (Windows operating system) or *`matlabroot`*`/toolbox/distcomp/bin` (UNIX operating system). Enter the following command syntax at a DOS or UNIX command-line prompt, respectively.

`startjobmanager -`*`flags`* accepts the following input flags. Multiple flags can be used together on the same command.

Flag	Operation
`-name <job_manager_name>`	Specifies the name of the job manager. This identifies the job manager to MATLAB worker sessions and MATLAB clients. The default is the value of the `DEFAULT_JOB_MANAGER_NAME` parameter in the `mdce_def` file.
`-remotehost <hostname>`	Specifies the name of the host where you want to start the job manager and the job manager lookup process. If omitted, they are started on the local host.

Flag	Operation
`-clean`	Deletes all checkpoint information stored on disk from previous instances of this job manager before starting. This cleans the job manager so that it initializes with no jobs or tasks.
`-multicast`	Overrides the use of unicast to contact the job manager lookup process. It is recommended that you not use `-multicast` unless you are certain that multicast works on your network. This overrides the setting of `JOB_MANAGER_HOST` in the `mdce_def` file on the remote host, which would have the job manager use unicast. If this flag is omitted and `JOB_MANAGER_HOST` is empty, the job manager uses unicast to contact the job manager lookup process running on the same host.
`-baseport <port_number>`	Specifies the base port that the mdce service on the remote host is using. You need to specify this only if the value of `BASE_PORT` in the local `mdce_def` file does not match the base port being used by the mdce service on the remote host.
`-v`	Verbose mode displays the progress of the command execution.

Examples

Start the job manager `MyJobManager` on the local host.

```
startjobmanager -name MyJobManager
```

Start the job manager `MyJobManager` on the host `JMHost`.

```
startjobmanager -name MyJobManager -remotehost JMHost
```

See Also `mdce` | `nodestatus` | `startworker` | `stopjobmanager` | `stopworker`

Purpose

Start MATLAB worker session

Syntax

```
startworker
startworker -flags
```

Description

`startworker` starts a MATLAB worker process under the mdce service, which maintains it after that. The worker registers with the specified job manager, from which it will get tasks for evaluation. The mdce service must already be running on the specified computer.

The `startworker` executable resides in the folder *`matlabroot`*`\toolbox\distcomp\bin` (Windows operating system) or *`matlabroot`*`/toolbox/distcomp/bin` (UNIX operating system). Enter the following command syntax at a DOS or UNIX command-line prompt, respectively.

`startworker -`*`flags`* accepts the following input flags. Multiple flags can be used together on the same command, except where noted.

Flag	Operation
`-name <worker_name>`	Specifies the name of the MATLAB worker. The default is the value of the `DEFAULT_WORKER_NAME` parameter in the `mdce_def` file.
`-remotehost <hostname>`	Specifies the name of the computer where you want to start the MATLAB worker. If omitted, the worker is started on the local computer.
`-jobmanager <job_manager_name>`	Specifies the name of the job manager this MATLAB worker will receive tasks from. The default is the value of the `DEFAULT_JOB_MANAGER_NAME` parameter in the `mdce_def` file.

Flag	Operation
`-jobmanagerhost <job_manager_hostname>`	Specifies the host on which the job manager is running. The worker uses unicast to contact the job manager lookup process on that host to register with the job manager. This overrides the setting of `JOB_MANAGER_HOST` in the `mdce_def` file on the worker computer, which would also have the worker use unicast. Cannot be used together with `-multicast`.
`-multicast`	If you are certain that multicast works on your network, you can force the worker to use multicast to locate the job manager lookup process by specifying `-multicast`. Note: If you are using this flag to change the settings of and restart a stopped worker, then you should also use the `-clean` flag. Cannot be used together with `-jobmanagerhost`.
`-clean`	Deletes all checkpoint information associated with this worker name before starting.
`-baseport <port_number>`	Specifies the base port that the mdce service on the remote host is using. You only need to specify this if the value of `BASE_PORT` in the local `mdce_def` file does not match the base port being used by the mdce service on the remote host.
`-v`	Verbose mode displays the progress of the command execution.

Examples

Start a worker on the local host, using the default worker name, registering with the job manager `MyJobManager` on the host `JMHost`.

```
startworker -jobmanager MyJobManager -jobmanagerhost JMHost
```

Start a worker on the host `WorkerHost`, using the default worker name, and registering with the job manager `MyJobManager` on the host `JMHost`. (The following command should be entered on a single line.)

```
startworker -jobmanager MyJobManager -jobmanagerhost JMHost
               -remotehost WorkerHost
```

Start two workers, named `worker1` and `worker2`, on the host `WorkerHost`, registering with the job manager `MyJobManager` that is running on the host `JMHost`. Note that to start two workers on the same computer, you must give them different names. (Each of the two commands below should be entered on a single line.)

```
startworker -name worker1 -remotehost WorkerHost
               -jobmanager MyJobManager -jobmanagerhost JMHost
startworker -name worker2 -remotehost WorkerHost
               -jobmanager MyJobManager -jobmanagerhost JMHost
```

See Also

`mdce` | `nodestatus` | `startjobmanager` | `stopjobmanager` | `stopworker`

stopjobmanager

Purpose

Stop job manager process

Syntax

```
stopjobmanager
stopjobmanager -flags
```

Description

`stopjobmanager` stops a job manager that is running under the mdce service.

The `stopjobmanager` executable resides in the folder *`matlabroot`*`\toolbox\distcomp\bin` (Windows operating system) or *`matlabroot`*`/toolbox/distcomp/bin` (UNIX operating system). Enter the following command syntax at a DOS or UNIX command-line prompt, respectively.

`stopjobmanager` *`-flags`* accepts the following input flags. Multiple flags can be used together on the same command.

Flag	Operation
`-name <job_manager_name>`	Specifies the name of the job manager to stop. The default is the value of `DEFAULT_JOB_MANAGER_NAME` parameter the `mdce_def` file.
`-remotehost <hostname>`	Specifies the name of the host where you want to stop the job manager and the associated job manager lookup process. The default value is the local host.
`-clean`	Deletes all checkpoint information stored on disk for the current instance of this job manager after stopping it. This cleans the job manager of all its job and task data.

Flag	Operation
`-baseport <port_number>`	Specifies the base port that the mdce service on the remote host is using. You need to specify this only if the value of `BASE_PORT` in the local `mdce_def` file does not match the base port being used by the mdce service on the remote host.
`-v`	Verbose mode displays the progress of the command execution.

Examples

Stop the job manager `MyJobManager` on the local host.

```
stopjobmanager -name MyJobManager
```

Stop the job manager `MyJobManager` on the host `JMHost`.

```
stopjobmanager -name MyJobManager -remotehost JMHost
```

See Also

`mdce` | `nodestatus` | `startjobmanager` | `startworker` | `stopworker`

stopworker

Purpose Stop MATLAB worker session

Syntax

```
stopworker
stopworker -flags
```

Description

`stopworker` stops a MATLAB worker process that is running under the mdce service.

The `stopworker` executable resides in the folder *`matlabroot`*`\toolbox\distcomp\bin` (Windows operating system) or *`matlabroot`*`/toolbox/distcomp/bin` (UNIX operating system). Enter the following command syntax at a DOS or UNIX command-line prompt, respectively.

`stopworker -`*`flags`* accepts the following input flags. Multiple flags can be used together on the same command.

Flag	Operation
`-name <worker_name>`	Specifies the name of the MATLAB worker to stop. The default is the value of the `DEFAULT_WORKER_NAME` parameter in the `mdce_def` file.
`-remotehost <hostname>`	Specifies the name of the host where you want to stop the MATLAB worker. The default value is the local host.
`-clean`	Deletes all checkpoint information associated with this worker name after stopping it.

Flag	Operation
`-baseport <port_number>`	Specifies the base port that the mdce service on the remote host is using. You need to specify this only if the value of `BASE_PORT` in the local `mdce_def` file does not match the base port being used by the mdce service on the remote host.
`-v`	Verbose mode displays the progress of the command execution.

Examples

Stop the worker with the default name on the local host.

```
stopworker
```

Stop the worker with the default name, running on the computer `WorkerHost`.

```
stopworker -remotehost WorkerHost
```

Stop the workers named `worker1` and `worker2`, running on the computer `WorkerHost`.

```
stopworker -name worker1 -remotehost WorkerHost
stopworker -name worker2 -remotehost WorkerHost
```

See Also

`mdce | nodestatus | startjobmanager | startworker | stopjobmanager`

Glossary

CHECKPOINTBASE
The name of the parameter in the `mdce_def` file that defines the location of the job manager and worker checkpoint directories.

checkpoint directory
Location where job manager checkpoint information and worker checkpoint information is stored.

client
The MATLAB session that defines and submits the job. This is the MATLAB session in which the programmer usually develops and prototypes applications. Also known as the MATLAB client.

client computer
The computer running the MATLAB client.

cluster
A collection of computers that are connected via a network and intended for a common purpose.

coarse-grained application
An application for which run time is significantly greater than the communication time needed to start and stop the program. Coarse-grained distributed applications are also called embarrassingly parallel applications.

codistributed array
An array partitioned into segments, with each segment residing in the workspace of a different lab.

Composite
An object in a MATLAB client session that provides access to data values stored on the labs in a MATLAB pool, such as the values of variables that are assigned inside an `spmd` statement.

computer
A system with one or more processors.

distributed application

The same application that runs independently on several nodes, possibly with different input parameters. There is no communication, shared data, or synchronization points between the nodes. Distributed applications can be either coarse-grained or fine-grained.

distributed computing

Computing with distributed applications, running the application on several nodes simultaneously.

distributed computing demos

Demonstration programs that use Parallel Computing Toolbox software, as opposed to sequential demos.

DNS

Domain Name System. A system that translates Internet domain names into IP addresses.

dynamic licensing

The ability of a MATLAB worker or lab to employ all the functionality you are licensed for in the MATLAB client, while checking out only a server product license. When a job is created in the MATLAB client with Parallel Computing Toolbox software, the products for which the client is licensed will be available for all workers or labs that evaluate tasks for that job. This allows you to run any code on the cluster for which you are licensed on your MATLAB client, without requiring extra licenses for the worker beyond that for the MATLAB Distributed Computing Server product. For a list of products that are not eligible for use with Parallel Computing Toolbox software, see `http://www.mathworks.com/products/ineligible_programs/`.

fine-grained application

An application for which run time is significantly less than the communication time needed to start and stop the program. Compare to coarse-grained applications.

head node

Usually, the node of the cluster designated for running the job manager and license manager. It is often useful to run all the nonworker-related processes on a single machine.

heterogeneous cluster
A cluster that is not homogeneous.

homogeneous cluster
A cluster of identical machines, in terms of both hardware and software.

job
The complete large-scale operation to perform in MATLAB, composed of a set of tasks.

job manager
The MathWorks process that queues jobs and assigns tasks to workers. A third-party process that performs this function is called a scheduler. The general term “scheduler” can also refer to a job manager.

job manager checkpoint information
Snapshot of information necessary for the job manager to recover from a system crash or reboot.

job manager database
The database that the job manager uses to store the information about its jobs and tasks.

job manager lookup process
The process that allows clients, workers, and job managers to find each other. It starts automatically when the job manager starts.

lab
When workers start, they work independently by default. They can then connect to each other and work together as peers, and are then referred to as labs.

LOGDIR
The name of the parameter in the `mdce_def` file that defines the directory where logs are stored.

MathWorks job manager
See job manager.

MATLAB client
See client.

MATLAB pool
A collection of labs that are reserved by the client for execution of `parfor`-loops or `spmd` statements. See also lab.

MATLAB worker
See worker.

mdce
The service that has to run on all machines before they can run a job manager or worker. This is the server foundation process, making sure that the job manager and worker processes that it controls are always running.

Note that the program and service name is all lowercase letters.

mdce_def file
The file that defines all the defaults for the mdce processes by allowing you to set preferences or definitions in the form of parameter values.

MPI
Message Passing Interface, the means by which labs communicate with each other while running tasks in the same job.

node
A computer that is part of a cluster.

parallel application
The same application that runs on several labs simultaneously, with communication, shared data, or synchronization points between the labs.

private array
An array which resides in the workspaces of one or more, but perhaps not all labs. There might or might not be a relationship between the values of these arrays among the labs.

random port
A random unprivileged TCP port, i.e., a random TCP port above 1024.

register a worker
The action that happens when both worker and job manager are started and the worker contacts job manager.

replicated array
An array which resides in the workspaces of all labs, and whose size and content are identical on all labs.

scheduler
The process, either third-party or the MathWorks job manager, that queues jobs and assigns tasks to workers.

spmd (single program multiple data)
A block of code that executes simultaneously on multiple labs in a MATLAB pool. Each lab can operate on a different data set or different portion of distributed data, and can communicate with other participating labs while performing the parallel computations.

task
One segment of a job to be evaluated by a worker.

variant array
An array which resides in the workspaces of all labs, but whose content differs on these labs.

worker
The MATLAB process that performs the task computations. Also known as the MATLAB worker or worker process.

worker checkpoint information
Files required by the worker during the execution of tasks.

Index